ANSI/ASAE S279.12 DEC02
Lighting and Marking of Agricultural Equipment on Highways

American Society of Agricultural Engineers

STANDARD

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Lighting and Marking of Agricultural Equipment on Highways

Supersedes ASAE S213, Safety Lighting for Combinations of Farm Tractors and Implements, adopted February 1954. Proposed by the Engineering Committee of the Farm and Industrial Equipment Institute; approved by SAE Power and Machinery Division Technical Committee; adopted by ASAE December 1964; revised December 1965, June 1966, June 1967, December 1969, June 1971, March 1974; approved as an American National Standard November 1976; revised April 1977, March 1982; revision approved by ANSI July 1984; reconfirmed December 1986; revised April 1988; editorially revised July 1989; revision approved by ANSI April 1990; reaffirmed by ASAE December 1992; reaffirmed by ANSI July 1993; reaffirmed by ASAE December 1997; revised April 1998; revision approved by ANSI and revised editorially October 1998; revised February 2001; revision approved by ANSI April 2001; reaffirmed by ASAE December 2001; revised December 2002; revision approved by ANSI February 2003.

1 Purpose

This Standard provides specifications for lighting and marking of agricultural equipment whenever such equipment is operating or is traveling on a highway.

2 Normative references

The following standards contain provisions that, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Standards organizations maintain registers of currently valid standards.

ANSI/ASAE S276.5 MAY98, *Slow-Moving Vehicle Identification Emblem*
ASAE S390.2 JAN01, *Definitions of Agricultural Equipment*
SAE J560, *Seven-Conductor Electrical Connector for Truck-Trailer Jumper Cable*
SAE J575, *Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width*
SAE J585, *Tail Lamps (Rear Position Lamps) for Use on Motor Vehicles Less Than 2032 mm in Overall Width*
SAE J588, *Turn Signal Lamps for use on Motor Vehicles Less Than 2032 mm in Overall Width*
SAE J594, *Reflex Reflectors*
SAE J974, *Flashing Warning Lamp for Agricultural Equipment*
SAE J975, *Headlamps for Agricultural Equipment*
SAE J2040, *Tail Lamps (Rear Position Lamps) for Use on Vehicles 2032 mm or More in Overall Width*
SAE J2041, *Reflex Reflectors for Use on Vehicles 2032 mm or More in Width.*
SAE J2261, *Stop Lamps and Front- and Rear-Turn Signal Lamps For Use On Motor Vehicles 2032 mm or more in Overall Width*
ASTM D-1014-95, *Practice for Conducting Exterior Exposure Tests of Paints on Steel*
ASTM D-4956-95, *Specification for Retroreflective Sheeting for Traffic Control*
ASTM E-991-90, *Practice for Color Measurement of Fluorescent Specimen*
ASTM E-308-96, *Practice for Computing the Colors of Objects by Using the CIE System*
FMVSS (Federal Motor Vehicle Safety Standard) PSTC-1 Adhesion Test 108, *Vehicle Lighting and Marking Standard*

3 Definitions and material specifications

3.1 agricultural equipment: Refer to ASAE S390 for definitions of agricultural equipment.

3.2 highway: A highway is defined as the entire width between the boundary lines of every way publicly maintained, when any part thereof is open to the use of the public for purposes of vehicular travel (Uniform Vehicle Code).

3.3 retroreflective devices:

3.3.1 Retroreflective material meeting the performance requirements of clause 3.5 or FMVSS 108 DOT C. Retroreflective material size shall be 50 mm (2 in.) wide by 115 mm (4.5 in.) long for machines 2 m (6.7 ft) or less in width, and 50 mm (2 in.) by 230 mm (9 in.) long for machines wider than 2 m (6.7 ft).

3.3.2 Reflex reflectors meeting the performance requirements of SAE J594 or SAE J2041 Type 1.

3.4 lamp location: Dimensions in this Standard, unless specified otherwise, are based on measurements to the nearest edge of the lens (filament cover).

3.5 retroreflective material:

3.5.1 Visibility. The material shall be visible at night from all distances between 305 and 30 m (1000 and 100 ft) when directly in front of lawful vehicle low beam headlamps.

3.5.2 Construction. Retroreflective sheeting shall consist of a smooth, flat, transparent exterior film with retroreflective elements embedded or suspended beneath the film so as to form a non-exposed retroreflective optical system.

3.5.3 Performance requirements. Retroreflective sheeting shall meet requirements of ASTM D-4956 for type V sheeting, except that the photometric requirements shall meet the minimum photometric performance requirements specified in table 1. The sheeting shall meet the color specification limits in table 2.

3.5.4 Exterior durability. Samples mounted on backing material specified in this Standard shall be exposed to the sun for a minimum test period of 24 months outside in south Florida at an angle of 45° to

Table 1 – Minimum photometric performance cd/(lx · m^2)

Observation angle, °	Entrance angle, °	Requirements	
		Red	Yellow
0.2	−4	60	168
0.2	30	60	168
0.2	45	15	40
0.5	−4	15	29
0.5	30	15	29
0.5	45	4	11

Table 2 – Color specification limits (daytime)

	1		2		3		4	
Color	*X*	*Y*	*X*	*Y*	*X*	*Y*	*X*	*Y*
Red	0.613	0.297	0.708	0.292	0.636	0.364	0.557	0.352
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472

horizontal facing upward and south, per ASTM D-1014. After exterior durability testing, the material shall show no cracking, crazing, blistering, loss of adhesion, or dimensional change, and shall meet the requirements in tables 1 and 2 when measured at 0.2° observation angle, and −4° entrance angle in accordance with ASTM D-4956 clause 8.3.

3.5.5 Corrosion resistance. Material shall be tested per SAE J575 and show no corrosion or edge fading and shall meet requirements of table 1 measured at 0.2° observation angle, and −4° entrance angle in accordance with ASTM D-4956 clause 8.3.

3.5.6 Adhesion. Backing material shall meet adhesive systems as specified in ASTM D-4956.

3.6 fluorescent material:

3.6.1 Visibility. The material shall be visible in the daylight as a red-orange fluorescent strip from all distances between 305 and 30 m (1000 and 100 ft).

3.6.2 Dimensional requirement. The fluorescent material size shall be 50 mm (2 in.) wide by 230 mm (9 in.) long.

3.6.3 Performance requirements. The red-orange color, purity, luminance, and peak reflectance of the fluorescent material shall be within the values shown in table 3 before and after the durability test.

3.6.4 Exterior durability. Samples shall be exposed to the sun for a test period of at least 24 months outside in south Florida at an angle of 45° to horizontal facing upward and south, per ASTM D-1014. After the durability test, the material shall show no cracking, crazing, blistering, loss of adhesion, or dimensional change, and shall meet the requirements set forth in this Standard.

Table 3 – Fluorescent values

	Before exposure test	After exposure test
Dominant wavelength, nm	602–610	585 min
Purity, %	84 min	77 min
Luminance, %	28 min	50 max
Peak reflectance observable at wavelength nearest dominant, %	>100	75 min

3.6.5 Color measurement. The spectrophotometric color values of the fluorescent material shall be determined by using a colorimetric spectrophotometer conforming to the requirements of ASTM E-991. Luminance shall be compared to that of a NIST (National Institute of Standards and Technology)-defined perfect reflecting diffuser (PRD) for CIE (Color Institute) illuminant D65. Because the fluorescent identification material can be expected to be viewed with an angular subtend of <4° at the eye, it is recommended that the CIE *X Y Z* values be calculated using the CIE 1931 (2°) standard observer and CIE illuminant D65. The CIE chromaticity coordinates, *X* and *Y*, shall be calculated as given below and defined in clause 7.3 of ASTM E-308.

$$\text{CIE } Y = \text{CIE } Y$$

$$x = \frac{X}{X+Y+X_{\text{CIE}}} \qquad y = \frac{Y}{X+Y+Z_{\text{CIE}}}$$

For example, given CIE $X = 37.87$, $Y = 34.05$, and $Z = 32.18$ for 2° D65 conditions, luminance factor $Y = 34.05$ and chromaticity values $x = +0.3638$ and $y = 0.3271$. The dominant wavelength and purity shall be determined using *x* and *y* from CIE diagrams. The values of *Y* shall be the luminance factor recorded as percent (luminance, %). From the spectral reflectance data, the maximum reflectance shall be no lower than the values shown in table 3.

3.6.6 Adhesion. Backing material shall be applied with a pressure sensitive adhesive having a minimum adhesive value of 1417 g (50 oz) per 25 mm (1 in.) width. Adhesion test shall be performed as specified in PSTC-1.

3.7 width: The width is defined as the widest measurement of the equipment in the highway transport configuration.

4 Lighting and marking requirements

4.1 Lighting and marking of tractors and self-propelled machines shall be as follows:

4.1.1 At least two headlamps generally conforming to SAE J975 mounted at the same height and spaced laterally as widely as practicable. Headlamps or the low beams of headlamps, if so equipped, shall be aligned such that measured at 7.6 m (25 ft) from the lamp, the horizontal line separating the upper edge of the lighted zone (line at which the intensity is decreased to 10% or less of the peak intensity) is 0.1 x H minimum below the center of the lamp, where H is the height of the lamp from the ground. The headlamp beams shall be centered laterally (see fig 1).

4.1.2 Work lamps or general service lamps shall be aimed downward to provide illumination close to the machine. Work lamps or general service lamps projecting to the rear shall not be illuminated during highway travel.

4.1.3 Two red tail lamps conforming to SAE J2040 symmetrically mounted to the rear of the machine and positioned as widely spaced laterally as practicable but no greater than 1.5 m (5 ft) to the left and right of the machine center and between 1 and 3 m (3.3 and 10 ft) high.

4.1.3.1 On machines less than 2 m (6.7 ft) in overall width, tail lamps conforming to SAE J585 may be used.

4.1.4 At least two amber flashing warning lamps conforming to SAE J974 as symmetrically mounted and as widely spaced laterally as practicable, visible from both front and rear, mounted between 1 and 3.7 m (3.3 and 12 ft) high. Lamps shall flash in unison at a rate of 60 to 85 flashes per minute.

4.1.4.1 On machines more than 3.7 m (12 ft) wide, at least two amber flashing warning lamps conforming to SAE J974 visible from front and rear shall be provided. The lamps shall be mounted between 1 and 3.7 m (3.3 and 12 ft) high and within 400 mm (16 in.) of the lateral extremities of the machine, and shall flash in unison with warning lamps described in clause 4.1.4. The extremity dimension includes such items as dual wheels, wide axles, headers, etc. These lamps may be used in addition to, or in place of, the lamps prescribed in clause 4.1.4.

4.1.5 Turn indicators shall be provided. When a turn is signaled, the amber flashing warning lamp(s) opposite the direction of turn shall become steady burning. The amber flashing warning lamp(s) in the direction of turn shall increase in flashing rate a minimum of 20 flashes per minute, but shall not exceed 110 flashes per minute. In addition, a rear-facing red or amber lamp conforming to SAE J2261 symmetrically mounted and positioned as widely spaced laterally as practicable but no greater than 1.5 m (5 ft) to the left and right of the machine center and between 1 and 3.7 m (3.3 and 12 ft) high shall flash in the direction of

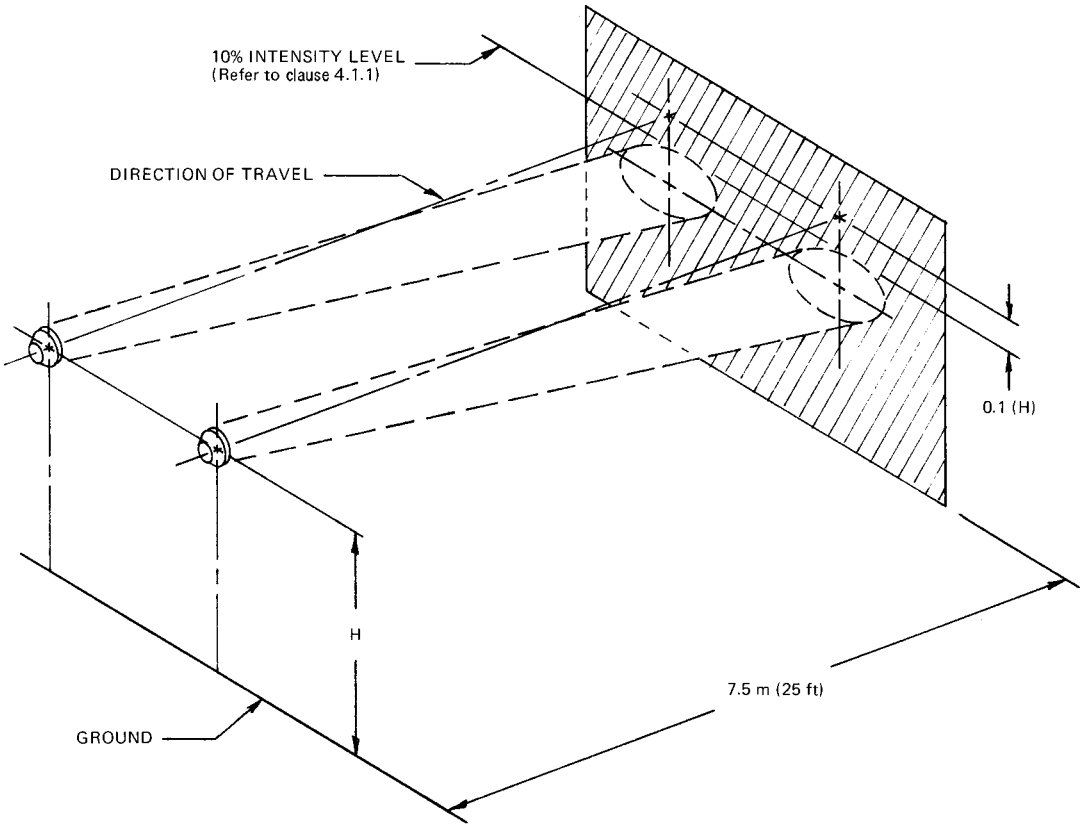

Figure 1 – Headlamp aiming procedure

turn and in unison with the amber flashing warning lamp(s). The additional lamp on the side opposite the turn may remain off, or on, or become brighter but shall not flash.

4.1.5.1 On machines less than 2 m (6.7 ft) in overall width, the additional rear facing red or amber lamps conforming to SAE J588 may be used.

4.1.6 At least two red retroreflective devices visible to the rear at night from all distances from 305 to 30 m (1000 to 100 ft) when directly in front of lawful vehicle low beam headlamps and mounted to indicate, as nearly as practicable, the extreme left and extreme right projections. Reflex reflectors meeting the requirements in clause 3.3.2 may be incorporated into the lens of the tail lamps described in clause 4.1.3 provided the tail lamps, when positioned according to clause 4.1.3, indicate as nearly as practicable the extreme left and extreme right projections.

4.1.7 On machines over 3.7 m (12 ft) wide, conspicuity material shall be provided which is visible from the front and rear of the unit.

4.1.7.1 The conspicuity material visible to the rear shall be red retroreflective material as defined in clause 3.3.1 and nonreflective red-orange fluorescent material as defined in clause 3.6. The retroreflective and fluorescent material shall be as horizontal as practicable and in line as practicable. The horizontal distance between any retroreflective material shall not exceed 1.8 m (6 ft). The horizontal distance between any fluorescent material shall not exceed 1.8 m (6 ft). The retroreflective and fluorescent material on the slow-moving vehicle identification emblem, SMV, may be included to meet these requirements. The outer edge of the retroreflective material shall be within 400 mm (16 in.) of the left and right extremities of the machine and as evenly spaced as practicable. The outer edge of the fluorescent material shall be within 635 mm (25 in.) of the left and right extremities of the machine and as evenly spaced as practicable.

4.1.7.2 The conspicuity material visible to the front shall be at least two strips of yellow retroreflective material as defined in clause 3.3.1. The outer edge of the left and right strips shall be within 400 mm (16 in.) of the left and right lateral extremities of the machine respectively.

4.1.8 One SMV (slow-moving vehicle) identification emblem as described in ANSI/ASAE S276.

4.1.9 One seven-terminal receptacle conforming to SAE J560 mounted on the machine and located as shown in figure 2. Tractors and self-propelled machines not primarily used with agricultural implements described in clauses 4.3.1 and 4.3.2 are excluded. (Examples are small garden and compact utility tractors, self-propelled windrowers, and high clearance sprayers.)

4.1.9.1 As a minimum, the receptacle terminal numbers 1, 3, 5, and 6 (ground, flashing and turn signals, and tail lamps), shall be wired for service.

4.1.9.2 The circuit designations for the breakaway connector defined in clause 4.1.9 are:

Table 4 – Tractor receptacle

Conductor identification	Wire color	Terminal number	Circuit
Wht	White	1	Ground
Blk	Black	2	Work lamps
Yel	Yellow	3	Left-hand flashing and turn Indicators
Red	Red	4	Auxiliary (Preferred switched)
Grn	Green	5	Right-hand flashing and turn Indicators
Brn	Brown	6	Tail lamps
Blu	Blue	7	Switched power (12 volt)

NOTE - Terminal 7 is to be controlled by the ignition/start key switch. See clause A.1 on implement bus breakaway connector.

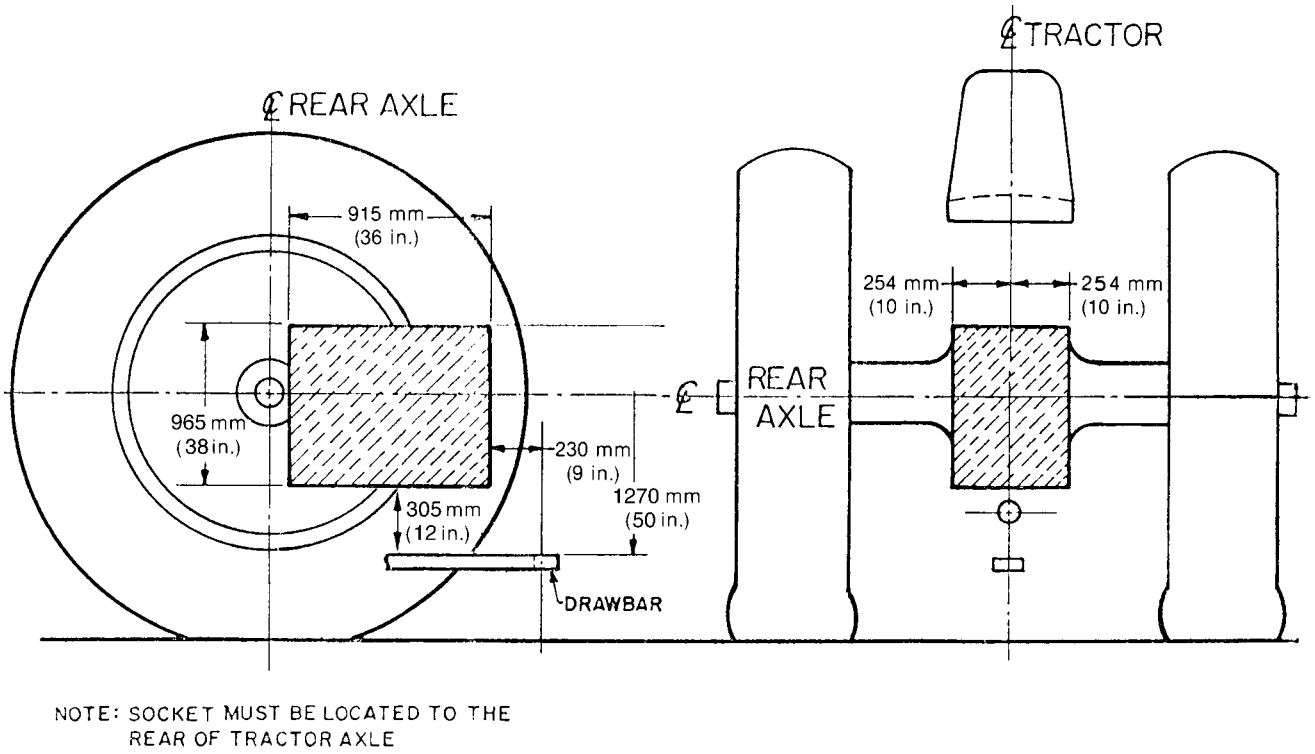

Figure 2 – Location zone for seven-terminal connector

4.2 Marking of non-self-propelled equipment

4.2.1 Marking of equipment that obscures SMV emblem. Equipment that obscures the SMV emblem on the propelling machine shall be equipped with one SMV emblem as described in ANSI/ASAE S276.

4.2.2 Marking for equipment width

4.2.2.1 Equipment extending more than 1.2 m (4 ft) to the left of the center of the propelling machine shall have at least one strip of yellow retroreflective material as defined in clause 3.3.1 visible to the front and positioned to indicate, as nearly as practicable, the extreme left projection of the equipment.

4.2.2.2 Equipment extending more than 1.2 m (4 ft) to the right or left of the centerline of the propelling machine shall have at least two strips of red retroreflective material as defined in clause 3.3.1, visible to the rear and mounted to indicate, as nearly as practicable, the extreme left and extreme right projections.

4.2.2.3 Equipment more than 3.7 m (12 ft) wide or extending more than 1.8 m (6 ft) to the right or left of the center and mounted and/or towed to the rear of the propelling machine shall have conspicuity material per clauses 4.2.2.3.1 and 4.2.2.3.2 as applicable.

4.2.2.3.1 The conspicuity material to the rear shall be red retroreflective material as defined in clause 3.3.1 and nonreflective red-orange fluorescent material as defined in clause 3.6. The strips of retroreflective and fluorescent material shall be as horizontal, in line and evenly spaced as practicable. The horizontal distance between strips of retroreflective material shall not exceed 1.8 m (6 ft). The horizontal distance between strips of fluorescent material shall not exceed 1.8 m (6 ft). The retroreflective and fluorescent material on the SMV may be included to meet these requirements. The outer edge of the outermost strips of retroreflective material shall be within 400 mm (16 in.) of the left and right extremities of the equipment. The outer edge of the outermost strips of fluorescent material shall be within 635 mm (25 in.) of the left and right extremities of the machine.

4.2.2.3.2 The conspicuity material visible to the front shall be at least two strips of yellow retroreflective material as defined in clause 3.3.1. The outer edge of the left and right strips shall be within 400 mm (16 in.) of the left and right lateral extremities of the machine respectively.

4.2.2.4 Equipment more than 3.7 m (12 ft) wide or extending more than 1.8 m (6 ft) to right or left of center and mounted to the front of the propelling machine shall have conspicuity material per clauses 4.2.2.4.1 and 4.2.2.4.2.

4.2.2.4.1 The conspicuity material visible to the front shall be at least two strips of yellow retroreflective material as defined in clause 3.3.1. The outer edge of the left and right strips shall be within 400 mm (16 in.) of the left and right extremities of the machine respectively.

4.2.2.4.2 The conspicuity material visible to the rear shall be red retroreflective material as defined in clause 3.3.1 and nonreflective red-orange fluorescent material as defined in clause 3.6. The strips of retroreflective and fluorescent material shall be as horizontal, in line and evenly spaced as practicable. The horizontal distance between strips of retroreflective material shall not exceed 1.8 m (6 ft). The horizontal distance between strips of fluorescent material shall not exceed 1.8 m (6 ft). The outer edge of the outermost strips of retroreflective material shall be within 400 mm (16 in.) of the left and right extremities of the equipment. The outer edge of the outermost strips of fluorescent material shall be within 635 mm (25 in.) of the left and right extremities of the machine. No conspicuity material is required for a horizontal distance of 1.2 m (4 ft) on either side of the propelling machine centerline.

4.2.3 Marking for equipment length

4.2.3.1 Equipment extending more than 1.2 m (4 ft) to the rear of the hitch point of the propelling machine shall have at least two red retroreflective devices visible to the rear and mounted to indicate, as nearly as practicable, the extreme left and extreme right projections.

4.2.3.2 Equipment, including combinations of towed equipment that are hitched together, extending more than 5 m (16.4 ft) to the rear of the tractor or self-propelled machine hitch point shall be equipped with at least one unobscured SMV emblem per ANSI/ASAE S276 and shall have yellow retroreflective material as defined in clause 3.3.1 visible from the left and right sides. The strips of retroreflective material shall be spaced

at intervals of 5 m (16.4 ft) maximum on both sides measuring from the tractor or self-propelled machine hitch point, with the rear most reflector positioned as far rearward as practicable.

4.3 Lighting of non-self-propelled equipment

4.3.1 Lighting of equipment that obscures vehicle illumination

4.3.1.1 Equipment that obscures the effective illumination of any flashing warning lamp, tail lamp, or extremity lamp on the propelling machine shall be fitted with lighting as described in clauses 4.3.1.1.1, 4.3.1.1.2, and/or 4.3.1.1.3 as appropriate to take the place of the lamp(s) obscured.

4.3.1.1.1 If the tail lamps on the propelling machine are obscured, at least two red tail lamps conforming to SAE J2040 symmetrically mounted to the rear of the machine and positioned between 0.6 and 1.5 m (2 and 5 ft) to the left and right of the machine center and between 1 and 3 m (3.3 and 10 ft) high. On machines less than 2 m (6.7 ft) in overall width, tail lamps conforming to SAE J585 may be used and positioned as widely spaced laterally as practicable and between 1 and 3 m (3.3 and 10 ft) high.

4.3.1.1.2 If the rear flashing warning lamps are obscured, at least two amber flashing warning lamps conforming to SAE J974 visible from the rear shall be provided. If the front flashing warning lamps are obscured, at least two amber flashing warning lamps conforming to SAE J974 visible from the front shall be provided. The lamps shall be symmetrically mounted and as widely spaced laterally as practicable, preferably mounted between 1 and 3 m (3.3 and 10 ft) in height, but may be mounted between 0.6 m (2 ft) and 3.7 m (12 ft) if required by machine design**,** and shall flash in unison with warning lamps described in clause 4.1.4. On non-symmetrical equipment extending only to the left or right which only obscures one flashing warning lamp, such as moldboard plows or windrowers, one flashing warning lamp shall be provided spaced laterally to within 400 mm (16 in.) of the projecting extremity.

4.3.1.1.3 If the rear turn indicators on the propelling machine are obscured, rear turn indicators shall be provided on the equipment consistent with clause 4.1.5. If the front turn indicators on the propelling machine are obscured, front turn indicators shall be provided.

4.3.2 Lighting for equipment width

4.3.2.1 Equipment that is more than 3.7 m (12 ft) wide or extends more than 1.8 m (6 ft) to the left or right of the centerline and beyond the left or right extremity of the propelling machine shall have lighting as described in clauses 4.3.2.1.1, 4.3.2.1.2 and 4.3.2.1.3.

4.3.2.1.1 At least two amber flashing warning lamps conforming to SAE J974 visible from front and rear shall be provided. The lamps shall be spaced to within 400 mm (16 in.) of the lateral extremities of the machine, preferably mounted between 1 and 3 m (3.3 and 10 ft) in height, but may be mounted between 0.6 m (2 ft) and 3.7 m (12 ft) if required by machine design, and shall flash in unison with warning lamps described in clause 4.1.4. On non-symmetrical equipment extending only to the left or right, such as moldboard plows or windrowers, one flashing warning lamp shall be provided spaced laterally to within 400 mm (16 in.) of the projecting extremity.

4.3.2.1.2 Two red tail lamps conforming to SAE J2040 symmetrically mounted to the rear of the machine and positioned between 0.6 m (2 ft) and 1.5 m (5 ft) to the left and right of the machine center. If the tail lamps on the propelling machine are not obscured, the tail lamps may be positioned more than 1.5 m (5 ft) to the left and right of the machine center. On equipment that is less than 1.2 m (4 ft) wide at the rear most part of the equipment, only one red tail lamp is required (e.g. grain augers). The red tail lamps shall be mounted as close to the rear as practicable and between 1 m (3.3 ft) and 3 m (10 ft) high.

4.3.2.1.3 Turn indicators shall be provided on the equipment consistent with clause 4.1.5. On equipment that is less than 1.2 m (4 ft) wide at the rear most part of the equipment (e.g. grain augers) and equipped with only one red tail lamp, turn indicators are not required.

4.3.3 Lighting for equipment length

4.3.3.1 Equipment that extends more than 7.6 m (25 ft) to the rear of the hitch point shall have lighting as described in clauses 4.3.2.1.1, 4.3.2.1.2, and 4.3.2.1.3.

4.3.4 A seven-terminal plug conforming to SAE J560 shall be provided for operating remote flashing warning lamps, turn indicators, and tail lamp(s). The plug location and cable length shall be compatible with the location of the seven-terminal receptacle on the tractor or self-propelled machine (see clause 4.1.9) as shown in figure 2. The circuit designation shall be consistent with clause 4.1.9.2. See A.2 on implement bus breakaway connector.

Annex A
(informative)
Future Provisions

NOTE - Future provisions are intended to provide lead time for conformance. The intent is to review them annually.

A.1 (Proposed clause 4.1.10) An implement bus breakaway connector as specified in ISO 11783-2 and light control messages as defined in ISO 11783-7.

A.2 (Proposed clause 4.3.4) An implement bus breakaway connector as specified in ISO 11783-2 and light control messages as defined in ISO 11783-7.